[RISK ASSESSMENT & DISASTER MANAGEMENT]

SGR Laboratories Pvt. Ltd. is proposed to manufacture Bulk Drugs & Intermediates at survey No. 290 & Parts, Dondapadu (V), Chinthalapalem (M), Suryapet District, Telangana State and is covered under **Category- A** of the EIA Notification – 2006. Public Hearing was held on 07-08-2019 at the project site. PH minutes are enclosed as Enclosure –I.

7.1 ADDITIONAL STUDIES

In order to support the environment impact assessment and environment management plan, following additional studies have been included in this report.

- Risk Assessment
- Disaster management plan
- Occupational Health

7.1.1 SCOPE OF THIS STUDY

The QRA (Quantitative Risk Assessment) study in this report has been conducted considering the Terms of References (TORs) given for Environment Clearance (EC). The study has been carried out with a view to comply TOR points with respect to Risk assessment.

7.1.2 Methodology:

The following parameters are considered to prepare Quantitative Risk Assessment.

1. Discussions were held with Plant officials on proposed individual safety systems of plant operations.
2. Hazard Identification exercise in coordination with plant officials was conducted taking into consideration the proposed storage of Hazardous Chemicals/Solvents, operating parameters and proposed safety systems.
3. Containment failure scenarios related to flammable chemicals & hazardous chemicals have been considered for Risk Assessment and consequences in detail. Thus, this study is mainly oriented towards acute risks rather than chronic risks.
4. Discussed on proposed Raw materials Hazards and their Risks in handling.

7.2 Risk Assessment

SGR Laboratories Pvt. Ltd. will handle various chemicals, some of which are hazardous in nature by virtue of their intrinsic chemical properties or their operating temperatures or pressures or a combination of them. Fire, explosion, toxic release or combinations of them are the hazards associated with industrial plants using hazardous chemicals. More comprehensive and systematic methods have been adopted in Hazard Identification and Quantitative Risk Assessment to improve upon the integrity, reliability and safety of the plants. The same has been discussed in detail under their respective headings.

7.2.1 Objectives of Risk Assessment

Risk analysis follows an extensive hazard analysis. It involves the identification and assessment of risks the neighboring populations are exposed to as a result of hazards present. This requires a thorough knowledge of failure probability, credible accident scenario, vulnerability of population etc., much of this information is difficult to get or generate. Consequently, the risk analysis is often confined to maximum credible accident studies.

The risk assessment process is primarily based on likelihood of occurrence of the risks identified and their possible hazard consequences particularly being evaluated through hypothetical accident scenarios. With respect to the proposed project, major risks are leaks from storage tanks, rupture of Pipelines, Spillages from containers during transfer operations and Storage in the Ware house have been assessed. Risk associated with the flammable chemicals storages have been determined semi-quantitatively as the product of likelihood/probability and severity/consequence by using order of magnitude data (risk ranking = severity/consequence factor X likelihood/probability factor). Significance of such project related risks have been established through their classification as high, medium, low, very low depending upon risk ranking.

It provides basis for**:**

- The type and nature of its on-site and off-site emergency plan
- The types of safety measures required

7.2.2 IDENTIFICATION OF HAZARDS

- Hazard identification is carried out to ascertain the controls required and available in order to mitigate the risk of exposure to the hazards. This would substantially help in overcoming costly errors and prolonged delays that may be caused due to the design changes that may be required on a later date.
- Hazard assessment in the proposed plant is carried out examining the Liquid and solid chemicals storage in the ware house, production operations of toxic chemicals such as Thionyl chloride and solid chemicals such as Sodium borohydride, Potassium hydroxide, Raney Nickel and Storage of Flammable liquid chemicals such as Methanol, Toluene, Acetone, Ethyl Acetate, IPA, n-hexane, in bulk quantities in plant premises, locations to find out the adequate facilities in place to overcome the Risks of exposure to the Hazards.

Following are the Hazards identified in proposed plant activities**:**

- Fire Hazards due to Flammable chemicals leakage from storage tanks, pipe line ruptures during transfer of material which may get ignited due to any spark.
- Fire Hazard due to improper earthing of storage tanks and material transfer lines
- Fire hazard due to leakage of flammable chemicals from transfer pumps gland leaks.
- Spillage/Leakage of Hazardous chemicals – Solvents, Acetic acid, HCl, Thionyl chloride which leads to Air pollution, Water pollution and Soil pollution
- Hydrogen gas explosion at high pressure during Lopinavir and Ritonavir production.

The exposure to hazards depends upon the concentration of hazard, Frequency and duration. The exposure to hazard could be controlled by reducing either the concentration of hazard, frequency or duration.

After a critical analysis of the chemicals propose to use, stored and for products to manufacture a defined safe operating procedures will be in place with safety and mitigation measures to overcome the hazards.

The exposure to the hazard could be controlled by implementing the following:

- Engineering controls at the source

- Environmental controls that remove the hazard from the environment
- Inspection of solvents transfers pipelines & Hydrogen gas conveying lines once in a month.
- Earthing to all storage tanks and providing jumpers to transfer pipe lines to have continuity of earthing.
- Process reactor which is proposing to use for hydrogenation should be kept away from production block to minimize the effect in case of explosion.
- Providing suitable personal protective equipment
- Employing experienced trained personnel

All the proposed process reactors will have temperature control and pressure control system for process as well as suitable Rupture disc followed by a safety valve to avoid explosion due to excess pressure.

TABLE 7.1: AREA WISE IDENTIFIED HAZARDS, PRECAUTIONS PROPOSED WITH MITIGATION MEASURES

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
1]	Raw Material Storage area	Spillage of chemicals	Low to medium & 4 persons	1. Approved layout as per legal requirements. 2. Flame proof electrical fittings will be installed 3. Chemicals will be stored in safe Containers with secondary containment to prevent spillages. 4. Storage quantity is limited 5. Storage area will be well ventilated by a forced air ventilation system. 6. Material will be accessed only by authorized personnel using mechanized systems 7. Double door entry to ensure a clean atmosphere. 8. Showers will be provided for decontamination. 9. Personnel will be provided with full body protection suits and nose masks to prevent exposure to chemicals. 10. Fire hydrant system with hydrant points with hose reels and nozzles	1. Area will be cordoned off. 2. Information will be passed to Emergency control center is informed. 3. Information will be given to the declarer of emergency on the scale of Leakage. 4. Emergency Response teams will be kept on alert for swift response. 5. All hot works being carried out in the surrounding areas will be stopped 6. Personnel working in the area will be evacuated. 7. Spilled powders will be collected using vacuum cleaners. 8. The spillage will be cleared and the area is made fit work 9. In case of liquid chemical spillage, the container will be shifted from ware house to the outside for arresting the leakage and transferring the contents to another

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				will be installed to mitigate fire hazards 11. Fire extinguishers will be deployed adequately 12. Fully fledged medical center will be arranged 13. Periodical occupational health checks will be done to personnel working in the area to Access health effects, if any. 14. Liquid chemicals such as , MIBK,THF and Thionyl chloride will be stored in dedicated area. Solid chemicals such as Sodium borohydride, Sodium hydroxide, Potassium hydroxide will be stored in dedicated area. Solid and liquid chemicals will not be stored in the same area.	vessel depends on situation. The area where leakage is occurred will be neutralized if necessary and cleaned. The warehouse will have good ventilation so as to minimize the concentration of respective chemical in the working area.
2]	Solvents Storage area	Fire, Flammable area of vapor cloud	Medium to High & 2 persons	1. Storage facility will be provided in isolated area to have natural ventilation	1. Area will be cordoned off. 2. No Hot work will be carried out in the vicinity to prevent accidental

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				2. Flameproof electrical fittings to be allowed in storage area to prevent any fire hazard. 3. No electrical gadgets or items capable of generating static electric charges will be permitted in the area. 4. Personnel will be trained about Do's & Don'ts during emergency. 5. No heat sources will be permitted near the Facility. 6. Hot work will be controlled through a work permit system 7. For all storage tanks double earthing will be arranged 8. Adequate size Dyke wall will be provided to for containment in case of leakage of chemical /solvent. 9. Storage quantity and material will be handled by trained and authorized personnel. 10. Mechanical foam type fire & DCP fire extinguishers will be provided	spread of fire. 3. Personnel working in the area will be evacuated 4. Emergency control center will be informed 5. Information will be given to the declarer of emergency on the scale of Leakage of solvent, Fire. 6. Emergency Response teams will be kept on alert for swift response. 7. The leakage will be cleared and the area is made fit work 8. In case leakage is found, the contents will be transferred to a spare tank or in to HDPE drums.

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				at all solvent storage tanks 11. Fire hydrant system with hose reels will be provided in the solvents storage area. 12. Hydrocarbon detectors will be provided in the storage tanks area. 13. Flame arrestor will be provided for each storage tank.	
3]	Production Block	Spillages / Fire/ Toxic gas release	Low to medium 25 persons	1. Flame proof electrical fittings will be installed 2. Freight lift will be installed for movement of material 3. Material will be stored at production blocks in safe containers for batch charging with secondary containment to prevent Spillages. 4. Earthing and bonding will be carried out for all reactor vessels and pipelines 5. Nitrogen lines will be provided to reaction vessel to create inert atmosphere inside the reactor to avoid fire and explosion	1. Area will be cordoned off. 2. Power supply will be cut off to the area to prevent accidental fire. 3. All hot work carried out in the vicinity will be stopped. 4. Emergency control center will be informed. 5. Information will be given to the declarer of emergency on the scale of spillage / fire/Toxic gas release 6. Emergency Response teams will be kept on alert for swift response. 7. Personnel working in the area will be evacuated.

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				6. Work permit system will be implemented for hazard assessment in case of any hot work / work at elevated places. 7. Manufacturing area will be ventilated by a Forced air ventilation system to prevent formation of flammable mixture. 8. Fire hydrant system with hydrant points with hose reels and nozzles will be installed to mitigate fire hazards 9. Fire extinguishers will be deployed adequately 10. Emergency exit door will be provided to each floor for safe escape in case of emergency 11. Eye wash fountain / Body shower will be provided for decontamination at each floor. 12. Limit switches will be provided for centrifuges for safe operation. 13. Nitrogen purging will be arranged for each Centrifuge to	8. Scrubber will be kept in operating condition with caustic scrubbing solution 9. Fire hydrant system will be put in use. 10. If situation beyond control information will be given to Inspector of factories, police, fire department for their assistance.

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				prevent formation of explosive flammable mixture. 14. Each reactor will be connected to a scrubber to neutralize or decrease the pressure in case sudden rise in pressure.	
	Production operations	Toxic gases release	25 persons	Material will be transferred to reactor by experienced operating personnel under mild negative pressure to avoid release of fumes to atmosphere	1. Scrubber will be kept in operating condition with cooled water circulation during transfer of the material. 2. Emergency Response teams will be kept on alert for swift response 3. Area will be cordoned off. 4. Emergency control center will be informed 5. Information will be given to the declarer of emergency on the scale of Leakage. 6. Neighboring industries and statutory authorities will be informed in case situation is severe.
4]	Boiler House	Fire/ Explosion	Low to medium &	1. All requirements specified under Boiler Act will be followed	1. Shutting down the plant, declaring the emergency.

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
			2 persons	2. All electrical fittings will be of flame proof Type. 3. Entry will be restricted only to trained and authorized personnel to work in the area. 4. Fire extinguishers will be positioned at different locations in case of any Emergencies. 5. No material storage will be permitted in the Area. 6. Auto level controller for Water and high temperature alarms will be provided. 7. Water hardness will be checked on shift wise. 8. Area will be well ventilated and illuminated for safe working. 9. 24 x 7 manning of the area is done for monitoring of operation. 10. All maintenance /repair works will be carried out after issuing work permits and under constant supervision of experts. 11. Periodical cleaning of soot in	2. Electrical supply will be isolated. 3. Type of emergency will be informed to the emergency declarer/ central authority. 4. Emergency response teams will be kept on alert for swift action. 5. Movement of personnel and vehicles will be prohibited. Adequate no. of Fire hydrant system will be put in use.

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				furnace to prevent formation of explosive mixtures. 12. Checking of boiler internals as per given schedule to prevent Accidents. 13. Signage's will be displayed to inform personnel about the hazards present in the area	
5]	Diesel Generator	Noise & Fire	Low & 1 person	1. Noise abatement through modular acoustic paneling of D. G. set 2. Secondary containment is done to prevent Diesel leakage from day tanks. 3. Adequate no. of fire extinguishers will be kept to handle emergency. 4. Entry access to the area will be only for Authorized personnel.	1. Information will be given to Emergency control center. 2. Power supply will be cut off to the storage area to prevent accidental fire. 3. All hot work around the area will be stopped and the area will be cordoned off 4. The concerned maintenance personnel will be carried repairs to mitigate the leakages. 5. Emergency Response Team will be kept on alert for swift response. 6. Periodical occupational health checks will be done to personnel

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
					working in the area to assess exposure to noise.
6]	Electrical sub -station	Electric shock / fire	Low to Medium & 2 persons	1. Layout confirm to legal requirements as per Indian Electrical Rules. 2. Entry will be restricted to licensed and authorized personnel only. 3. Earthing will be provided for leakage of stray currents. 4. Electronic mimic panels will be installed for fault indication at the entry of the sub-station. 5. Insulating rubber mats confirming to IS: 15652- 2006 will be provided in front of all electrical panel boards. 6. Periodical inspection and maintenance will be carried out to ensure good health of the equipment. 7. CO_2 / DCP fire extinguishers will be deployed to handle emergency fires	1. Information will be given to Emergency control center. 2. Power supply will be cut off from incoming source. 3. Electricity supply company will be alerted for cut off power supply in case of major risks 4. All hot work around the area will be stopped and the area is cordoned off. 5. The concerned maintenance personnel will be carried repairs to restore normalcy. 6. Emergency Response Team will be kept on alert for swift response
7]	Hazardous waste storage shed	Fire/Leakage	Low to Medium & 1 Person	1. Storage shed will be at an isolated location. 2. Conditions specified in hazardous waste Authorization	1. Information will be given to Emergency control center. 2. Power supply will be cut off from incoming source.

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				issued by SPCB will be implemented. 3. Compatible wastes will be stored in separate enclosures 4. Layout provides adequate ventilation and illumination 5. Secondary containment provided to prevent leakages / spillages 6. Storage quantity will be limited. 7. Periodical disposal of accumulated waste will be sent to authorize landfills. 8. Flame proof electrical fittings will be installed to prevent fire / explosion hazards 9. Eye wash / body shower will be provided for decontamination in case of spillage on body parts. 10. PPE box will be equipped with gum boots, splash proof safety goggles, aprons for use during handling of chemicals. 11. Access to the area will be restricted to authorize personnel	3. All hot work around the area will be stopped and the area is cordoned off 4. The concerned maintenance personnel will be carried repairs to restore normalcy 5. Fire hydrant system will be put in use 6. Emergency Response Team will be kept on alert for swift response. 7. Support of external agencies will be sought in case situation poses major risks and is not controllable by in-house infrastructure

S. No.	AREA	IDENTIFIED HAZARD	SEVERITY & NO. OF PERSONS EXPOSED	PRECAUTIONS PROPOSED	MITIGATION MEASURES
				only. 12. Fire hydrant point with hose reels will be provided for fire mitigation	

7.3 List of Solvents/Chemicals

Table 7.2: LIST OF SOLVENTS/ CHEMICALS

S. No	NAME OF SOLVENT/CHEMICAL	PHYSICAL STATE	MODE OF STORAGE	MAX. INVENTORY IN TONS	NATURE OF HAZARD	NFPA RATING
1	Methanol	Liquid	MS Tank	40	Flammable	**H : 1 F: 3 R : 0**
2	Toluene	Liquid	MS Tank	40	Flammable	**H : 2 F: 3 R : 0**
3	MDC	Liquid	MS Tank	20	Harmful	**H : 2 F: 1 R : 0**
4	Acetone	Liquid	MS Tank	20	Flammable	**H : 1 F: 3 R : 0**
5	Ethyl acetate	Liquid	MS Tank	10	Flammable	**H : 1 F: 3 R : 0**
6	HCl	Liquid	PP+FRP Tank	2	Corrosive	**H:3 F:0 R:1**
7	Sulfuric acid	Liquid	HDPE Carboys	0.5	Corrosive	**H:3 F:0 R:2**
8	Hydrogen	Gas	Cylinders	50 nos	Explosive	**H:0 F:4 R:0**
9	THF	Liquid	HDPE Drums	5	Flammable	**H : 2 F: 3 R : 1**
10	Thionyl chloride	Liquid	HDPE Carboys	2	Toxic	**H:4 F:0 R:2**
11	Raney nickel	Solid	HDPE Carboys	0.1	Flammable	**H:2 F:4 R:1**
12	Sodium borohydride	Solid	HDPE Carboys	0.3	Flammable	**H:3 F:4 R:2**
13	n-Hexane	Liquid	HDPE Drums	3	Flammable	**H:1 F:3 R:0**
14	DMF	Liquid	HDPE Drums	1	Flammable	**H:1 F:2 R:0**
15	Acetic acid	Liquid	HDPE Drums	0.3	Corrosive	**H:3 F:2 R:0**
16	IPA	Liquid	MS Tank	20	Flammable	**H : 1 F: 3 R : 0**

7.4 Potential Hazards of solvents and chemicals

Acetone: It is a clear, volatile, flammable liquid. Vapors may form explosive mixtures with air. Vapors are heavier than air and may travel along the ground to some distance source of ignition and flash back.

On combustion may emit toxic fumes of carbon monoxide and CO_2.
This product causes irritation of eyes, skin, and mucous membranes in case of contact. It will cause lung damage if swallowed. Do not breathe vapors.
Flash point: -20^o C. Boiling point; 56.2^o C
Explosive limits: Lower: 2.6%
Upper: 12.8 %

N-Hexane: It is a clear, volatile, highly flammable liquid. Vapors may form explosive mixture with air. Vapors are heavier than air and may travel along the ground to some distance source of ignition and flash back. Fire or intense heat may cause violent rupture of packages. Hazardous combustion products may include carbon monoxide, carbon dioxide.

Use foam, carbon dioxide or dry chemical. Suppress vapors/mists with a water spray jet.

In case of spillage soak up with inert absorbent material such as sand, silica gel, saw dust. Do not use sparking tools. Do not allow product to enter sewer or waterways.

Store in a well-ventilated place to effectively remove and prevent buildup of any vapors or mists generated from handling of this product.

While handling wear impervious gloves and anti-static protective clothing. For leak, spills, or other emergency, use full protective equipment.
It is incompatible with oxidizers, halogens, chromates, perchlorates, peroxides.
Flash point: -22^o C. Boiling point; 69^o C
Explosive limits: Lower: 1.1%
Upper: 7.5 %

Methanol: Extremely flammable and vapor may form ignitable vapor- air mixtures in storage tanks or other containers. Ignition and busing can release carbon monoxide, carbon dioxide and non combustible hydrocarbons (Smoke)

Use foam, carbon dioxide or dry chemical. Suppress vapors/mists with a water spray jet.

While handling wear impervious gloves and anti-static protective clothing. For leak, spills, or other emergency, use full protective equipment.

Inhalation can Cause dizziness, head ache and nausea, kidney and liver disorder

Flash point: 12^{o} C. Boiling point; 64.5^{o} C

Explosive limits: Lower: 6%

Upper: 36.5 %

Raney nickel catalyst: Keep container tightly closed and to be stored in a cool, well-ventilated area. Do not allow material to dry. If allowed to dry in air, it turns to red hot and provides a combustion source for exposed combustible materials.

It should be kept away from incompatibles such as oxidizing agents, combustible materials, organic materials, metals, acids, flammable solvents and source of ignition.

In case of spill, do not touch the spilled material. Cover with wet earth and sand. Eliminate all ignition sources.

Always use protective clothing with dust respirator and goggles while handling.

Hydrogen: It is a flammable, colorless, compressed gas packaged in cylinders at high pressure. It poses an immediate fire and explosive hazard when concentrations exceed 4%. It is much lighter than air and burns with an invisible flame.

It should be noted that, before suffocation could occur, the lower flammability of hydrogen in air would exceed possibly causing both an oxygen-deficient and explosive atmosphere. Exposure to moderate concentrations may cause dizziness, headache, nausea and unconsciousness.

Cylinder storage locations should be well protected, well ventilated, dry, and separated from combustible materials. Cylinders should never knowingly be allowed to reach a temperature exceeding 52 ^{0}C. Cylinders of hydrogen should be separated

from oxygen cylinders or other oxidizers by minimum distance of 20 ft. Do not keep any other cylinders in Hydrogen storage area.

Cylinders should be stored upright with valve protection cap in place and firmly secured to prevent falling or being knocked over. Protect cylinders from physical damage, do not drag, roll, slide or drop. Post “No Smoking or Open flames” signs in the storage areas. There should not be any sources of ignition.
All electrical equipment should be explosion proof in the storage and use areas. Provide natural or explosion-proof ventilation adequate to ensure hydrogen does not reach its lower explosive limit of 4% .Hydrogen is incompatible with oxidizing agents.

Sulfuric acid: Water Reaction
Reaction with water is negligible unless acid strength is above 70% then heat from hydrolysis is extreme, may cause severe burns
Fire Hazard
It is highly reactive and capable of igniting finely-divided combustible materials on contact. When heated, it emits highly toxic fumes. Avoid heat; water and organic materials. Sulfuric acid is explosive or incompatible with an enormous array of substances. It can undergo violent chemical change at elevated temperatures and pressure. It may react violently with water.

Health Hazard:
Corrosive to all body tissues. Inhalation of vapor may cause serious lung damage. Contact with eyes may result in total loss of vision. Skin contact may produce severe necrosis.

Fatal amount for adult: between 1 teaspoonful and one-half ounce of the concentrated chemical. Chronic exposure may cause tracheobronchitis, stomatitis, conjunctivitis, and gastritis. Those with chronic respiratory, gastrointestinal, or nervous diseases and any eye and skin diseases are at greater risk.

Protective Clothing:
Skin: Wear appropriate personal protective clothing to prevent skin contact. Eyes: Wear appropriate eye protection to prevent eye contact.

Wash skin: The worker should immediately wash the skin when it becomes contaminated.

Remove: Work clothing that becomes wet or significantly contaminated should be removed and replaced. Provide: Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection.

Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure.

It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from anybody areas likely to be exposed.

Hydrochloric acid:

Water Reaction

It is an aqueous solution. Dilution may generate heat. Fumes in air.

Fire Hazard

Special Hazards of Combustion Products: Toxic and irritating vapors are generated when heated.

Health Hazard

Inhalation of fumes results in coughing and choking sensation, and irritation of nose and lungs. Liquid causes burns.

Reactivity Profile

Hydrochloric Acid is an aqueous solution of hydrogen chloride, an acidic gas. Reacts exothermically with organic bases (amines, amides) and inorganic bases (oxides and hydroxides of metals).

Reacts exothermically with carbonates (including limestone and building materials containing limestone) and hydrogen carbonates to generate carbon dioxide.

Reacts with sulfides, carbides, borides, and phosphates to generate toxic or flammable gases.

Reacts with many metals (including aluminum, zinc, calcium, magnesium, iron, tin and all of the alkali metals) to generate flammable hydrogen gas.

Protective Clothing:

Skin: If chemical is in solution, wear appropriate personal protective clothing to prevent skin contact and to prevent skin from becoming frozen from contact with the liquid or from contact with vessels containing the liquid.

Eyes: Wear appropriate eye protection to prevent eye contact with the liquid that could result in burns or tissue damage from frostbite.

Wash skin: If the chemical is in solution, the worker should immediately wash the skin when it becomes contaminated.

Remove: If chemical is in solution, work clothing that becomes wet or significantly contaminated should be removed and replaced.

Provide: Eyewash fountains should be provided (when chemical is in solution) in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection. Facilities for quickly drenching the body should be provided (when chemical is in solution) within the immediate work area for emergency use where there is a possibility of exposure. It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from anybody areas likely to be exposed.

Quick drench facilities and/or eyewash fountains should be provided within the immediate work area for emergency use where there is any possibility of exposure to liquids that are extremely cold or rapidly evaporating.

Thionyl chloride:

A colorless to yellow fuming liquid with a suffocating pungent odor. A lachrymator. Highly corrosive and toxic.

Long-term inhalation of low concentrations or short-term inhalation of high concentrations has adverse health effects.

Emits dense corrosive fumes in moist air. Violently reacts with water to liberate hydrochloric acid and sulfur dioxide. Based on a scenario where the chemical is spilled into an excess of water (at least 5 fold excess of water), half of the maximum theoretical yield of Sulfur Dioxide gas will be created in 0.25 minutes.

Protective Clothing

Skin: Wear appropriate personal protective clothing to prevent skin contact. Eyes: Wear appropriate eye protection to prevent eye contact. Wash skin: The worker should immediately wash the skin when it becomes contaminated.

Provide eyewash fountains in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection

7.5. SAFE PRACTICES [HANDLING, STORAGE, TRANSPORTATION AND UNLOADING OF CHEMICALS]

Liquid Raw materials will be transferred from the drums to the day tank situated at the production block with the help of leak proof drum pumps / AODD pumps /Vacuum. From day tank to process reactor unloading is by gravity.

7.5.1 Measures to Avoid Evaporation

- All liquid chemicals/solvents stored in containers will be tightly closed.
- Will Keep away from heat, sparks, and flame
- Will Keep away from sources of ignition
- Ammonia will be stored in well ventilated area away from combustibles, oxidizable materials etc.

7.5.2 Safety Systems

- Designated areas with proper indication & safety signs
- Double earthling systems for all solvent storage tanks & process reactors
- Flame arrestor to the vent of Solvent storage tanks
- Flame proof transferring pumps for all flammable chemicals
- Handling precautions/sop protocol
- Pressure Gauges and temperature gauges on each reactor
- Level indicators, Vent lines, earthing system on all solvent storage tanks(Methanol, Toluene, MDC, Ethyl acetate, ,Acetone,THF)
- Each solvent storage tank will be placed in dyke wall with Fire hydrant system
- Flame proof lighting to solvent storage yard
- Safety valve & Rupture disc on each process reactor.

- Well ventilated warehouse with suitable fire extinguishers will be used for storage of liquid chemicals/ Thionyl chloride/ HCl / H2SO4/Solid Chemicals.

7.5.3 TRANSPORTATION / UNLOADING

Highly inflammable chemicals will be transported by road. Therefore, adequate safety precautions for transportation will be followed. During transportation of hazardous chemicals, MSDS & TREM card will be provided to driver. As per Motor Vehicle Rules, PESO rules and Factory Rules all safety precautions will be followed during transportation of hazardous chemicals.

The following safety precautions are suggested during transportation of toxic, inflammable and corrosive chemicals in tankers, while loading and unloading, transportation and meeting the emergencies arising out of leakages and spillages of hazardous materials:

- The name of the chemical along with pictorial sign denoting the dangerous goods should be marked on the vehicle and the packing material.
- The name of the transporter, his address and telephone number should be clearly written on the road tanker and on the vehicle.
- Only trained drivers and cleaners should transport hazardous chemicals.
- The Tanker / Vehicle should be checked for its fitness and safe condition before loading.
- During loading and unloading, the tanker/vehicle should be braked and isolated against any movement, while loading/unloading, use safety appliances.
- Park the vehicle at designated place.
- Stop the engine.
- Check-up spark arrester.
- Provide earthing to tanker securely.
- Ensure that fireman is available near the place with proper equipment‘s.
- Connect the piping properly
- Before start unloading, check that, there should not be any leakage.
- In case of leakage, immediately attend the leakages & rectify it.
- After unloading is over, close the lid properly.
- Vehicle to be started only after removal of all pipelines connected with tanker.

7.5.4 SPILL CONTROL

- For all chemicals spill control procedures will be displayed. Spillage shall be controlled as per concerned spill control procedure.
- Like any spilled materials to contain, absorb spilled liquid by dry absorbent clay or vermiculite.
- Collect most of the contaminated absorbent with shovel for further disposal/incineration.
- If material spills directly on the ground, dig up and remove saturated soil for disposal/incineration.
- In case HCl/ H_2SO_4 spills on to the ground use dry absorbent clay/vermiculate and neutralize with sodium carbonate
- The plant is more vulnerable for solvent leakages, fire due to Raney nickel exposure to dry condition.

7.5.5 EFFECT AND CONSEQUENCE ANALYSIS

- In a plant handling hazardous chemicals, the main hazard due to storage & handling of solvents, Thionyl chloride, Hydrogen, HCl/ H_2SO_4, Sodium borohydride,
- If Flammable chemicals are released into the atmosphere, they may cause damage due to resulting fires or vapor clouds.
- Toxic gas dispersion due to leakage of Thionyl chloride into atmosphere may cause health problems to plant personnel and surrounding areas of the plant.

7.6 INVENTORY

- Inventory analysis is commonly used in understanding the relative hazards and short listing of release scenarios.
- Inventory plays an important role in regard to the potential hazard.
- Larger the inventory of a vessel or a system, larger the quantity of potential release.
- The potential vapor release [source strength] depends upon the quantity of liquid release, the properties of the materials and the operating conditions [pressure, temperature].

- If all these influencing parameters are combined into a matrix and vapor source strength estimated for each release case, a ranking should become a credible exercise.

7.7 LOSS OF CONTAINMENT

- Plant inventory can get discharged to environment due to Loss of Containment.
- Certain features of materials to be handled at the plant need to the clearly understood to firstly list out all significant release cases and then to short list release scenarios for a detailed examination.
- Liquid release can be either instantaneous or continuous.
- Failure of a vessel leading to an instantaneous outflow assumes the sudden appearance of such a major crack that practically all of the contents above the crack shall be released in a very short time.
- The more likely event is the case of liquid release from a hole in a pipe connected the vessel. The flow rate will depend on the size of the hole as well as on the pressure, which was present, in front of the hole, prior to the accident. Such pressure is basically dependent on the pressure in the vessel.
- The vaporization of released liquid depends on the vapor pressure and weather conditions.

In the study the largest potential hazard inventories have been considered for its consequence Risk estimation how vulnerable the organization is to a specific icident consequence.

There are a number of hazards that are present at the proposed project site that may result in injury to people or a fatality in more serious cases. This study is only concerned with ‘major hazards’, which are as follows:

- Pool fires
- Hydrocarbon fires associated with tank failures;
- Vapor cloud explosion;

Each of these hazards has been described below.

Jet Fire

Jet fires result from ignited releases of pressurized flammable gas or Superheated/pressurized liquid. The momentum of the release carries the material forward in a long plume entraining air to give a flammable mixture.

Jet fires only occur where any other flammable gas is being handled under pressure or when handled in gas phase and the release are unobstructed.

Pool Fires

If a liquid release has time to form a pool and is then ignited before the pool evaporates or drains away, then a pool fire results.

Because they are less well aerated, pool fires tend to have lower flame temperatures and produce lower levels of thermal radiation than some other types of fire (such as jet fires); however, this means that they will produce more smoke. Although a pool fire can still lead to structural failure of items within the flame, this will take several times longer than in a jet fire.

A burning liquid pool can spread along a horizontal surface or run down a vertical surface to give a running fire. Due to the presence of kerbs, slopes, drains and other obstacles; pool fire areas and directions can be unpredictable.

Vapour Cloud Explosion

The facility presently stores and also plans to store highly flammable Chemicals Methanol, Acetone, Toluene, MDC, Ethyl acetate, THF, Raney Nickel, etc. for a maximum credible loss scenario the release of such chemicals is likely to form a vapor cloud. If the cloud encounters an ignition source, the parts of the cloud where the concentration is within the flammable range will burn and may in some situations, also create an explosive force (blast wave). The effects of an explosion, defined by blast overpressure, can be significant.

In most VCEs the expanding flame front travels more slowly than the pressure Wave; this type of explosion is called a deflagration and the maximum Overpressure is determined by the expansion ratio of the burning gases. If the flame front travels fast enough to coincide with the pressure wave then the explosion is called a detonation and very severe overpressures can be produced. Detonation is most likely to occur with more reactive gases such as hydrogen.

Toxic vapor release:

Toxic vapor release due to Thionyl chloride leakage and effected area with airborne concentration.

7.8 Damage Criteria

In consequence analysis, use is made of a number of calculation models to estimate the physical effects of an accident [spill of hazardous material] and to predict the damage [lethality, injury, material destruction] of the effects. The calculations can roughly be divided in three major groups.

- Determination of the source strength parameters;
- Determination of the consequential effects;
- Determination of the damage or damage distances.

Table 7.3: Severity Categories and Criteria

Consequence	Ranking	Criteria Definition
Catastrophic	5	Multiple fatalities/permanent total disability
Major	4	Single fatality/permanent total disability
Moderate	3	Short term hospitalization & rehabilitation leading to recovery
Minor	2	Medical treatment injuries
Insignificant	1	First Aid treatment

Risk Evaluation

Based on ranking of likelihood and frequencies, each identified hazard has been evaluated based on the likelihood of occurrence and the magnitude of consequences. The significance of the risk is expressed as the product of likelihood and the consequence of the risk event, expressed as follows:

Significance = Likelihood X Consequence

The below table illustrates all possible product results for the five likelihood and consequence categories while the next table assigns risk significance criteria in three regions that identify the limit of risk acceptability.

Depending on the position of the intersection of a column with a row in the risk matrix, hazard prone activities have been classified as low, medium and high thereby qualifying for a set of risk reduction / mitigation strategies.

Risk Matrix

	Likelihood →					
Consequence		Frequent	Probable	Unlikely	Remote	Improbable
		5	4	3	2	1
Catastrophic	5	25	20	15	10	5
Major	4	20	16	12	8	4
Moderate	3	15	12	9	6	3
Minor	2	10	8	6	4	2
Insignificant	1	5	4	3	2	1

Risk Criteria and action Requirements

S. No.	Risk Significance	Criteria Definition & Action Requirements
1	High (16-25)	"Risk requires attention" – Project Management need to ensure that necessary mitigation are adopted to ensure that possible risk remains within acceptable limits.
2	Medium (10-15)	"Risk is tolerable" – Project Management to adopt necessary measures to prevent any change/modification of existing risk controls and ensure implementation of all practicable controls.
3	Low (5-9)	"Risk is acceptable" – Project related risks are managed by well established controls and routine processes/procedures. Implementation of additional controls can be considered.
4	Very Low (1-4)	"Risk is acceptable"- All risks are managed by well established controls and routine processes/procedures. Additional risk controls need not to be considered.

The basic physical effect models consist of the following.

Source strength parameters

- Calculation of the outflow of liquid, vapor out of a vessel or a pipe, in case of rupture. Also two-phase outflow can be calculated.
- Calculation, in case of liquid outflow, of the instantaneous flash evaporation and of the dimensions of the remaining liquid pool.
- Calculation of the evaporation rate, as a function of volatility of the material, pool dimensions and wind velocity.
- Source strength equals pump capacities, etc. is some cases.

Consequential effects

- Dispersion of gaseous material in the atmosphere as a function of source strength, relative density of the gas, weather conditions and topographical situation of the surrounding area.
- Intensity of heat radiation [in KW / m^2] due to a pool fire, as a function of the distance to the source.
- Energy of vapor cloud explosions [in KW / m^2], as a function of the distance to the distance of the exploding cloud.
- Concentration of gaseous material in the atmosphere, due to the dispersion of evaporated chemical. The latter can be either explosive or toxic.

It may be obvious, that the types of models that must be used in a specific risk study strongly depend upon the type of material involved:

- Gas, vapor, liquid, solid
- Inflammable, explosive, toxic products
- Stored at high/low temperatures or pressure.

Selection of Damage Criteria

- The damage criteria give the relation between extent of the physical effects (exposure) and the percentage of the people that will be killed or injured due to those effects
- The knowledge about these relations depends strongly on the exposure. For instance, much more is known about the damage caused by heat radiation, than about the damage due to toxic exposure, and for these toxic effects, the knowledge differs strongly between different materials.

In consequence analysis studies, in principle three types of exposure to hazardous effects are distinguished:

- Heat radiation from pool fire.
- Explosion
- Toxic effect from toxic materials or toxic combustion products.

Heat Radiation

The consequence caused by exposure to heat radiation is a function of:

- The radiation energy onto the human body [KW / m^2]
- The exposure duration [sec]
- The protection of the skin tissue [clothed or naked body]

7.9 DAMAGES TO HUMAN LIFE DUE TO HEAT RADIATION

Injuries to People —Definition of Burn Degrees

First Degree: A mild level of skin burn affecting the epidermis, with persistent redness but no formation of blisters. More severe first - degree burns will produce some pain, but no permanent damage. Flaking or scaling of the outer skin layer will occur several days after exposure.

Second Degree: An intermediate level of skin burn characterized by the formation of blisters. The blister depth may be shallow (epidermis), with only the surface layers of the skin damaged, or more severe with nearly the full depth of the skin destroyed (epidermis and dermis).

Third Degree: Deep burns characterized by the destruction of all skin layers and by charring. The underlying tissue may also be damaged.

Table 7.4 Heat flux Intensity and exposure time-Damage criteria for people

Thermal Radiation Intensity (kW/m2)	Type of Damage
1.6	No harm for long exposures.
4 to 5	Pain for 20 seconds exposure; first degree burn
9.5	Second degree burn after 20 Seconds
10 to 15	Potentially lethal with in 1 minute.
25	Significant injury in 10 seconds; 100 % lethality in 1 minute.
35 to 37.5	1 % lethality in 10 seconds.

Since in practical situations, only the own employees will be exposed to heat radiation in case of a fire, it is reasonable to assume the protection by clothing. It can be assumed that people would be able to find a cover or a shield against thermal radiation in 10 sec. time. Furthermore, 100% lethality may be assumed for all people suffering from direct contact with flames, such as the pool fire, a flash fire or a jet flame.

Explosion

In case of vapor cloud explosion, two physical effects may occur:

- A flash fire over the whole length of the explosive gas cloud;
- A blast wave, with typical peak overpressures circular around ignition source.

As explained above, 100% lethality is assumed for all people who are present within the cloud proper.

The following damage criteria may be distinguished with respect to the peak overpressures resulting from a blast wave:

Table 7.5: DAMAGE DUE TO OVERPRESSURES

PEAK OVERPRESSURE	DAMAGE TYPE
0.83 bar	Total destruction
0.30 bar	Heavy damage
0.10 bar	Moderate damage
0.03 bar	Significant damage
0.01 bar	Minor damage

7.10 MAXIMUM CREDIBLE LOSS ACCIDENT SCENARIOS

A Maximum Credible Accident (MCA) can be characterized as the worst credible accident. In other words: an accident in an activity, resulting in the maximum consequence distance that is still believed to be possible. A MCA-analysis does not include a quantification of the probability of occurrence of the accident. Another aspect, in which the pessimistic approach of MCA studies appears, is the atmospheric condition that is used for dispersion calculations. The Maximum Credible Loss (MCL) scenarios have been developed for the Facility. The MCL cases considered, attempt to include the worst “Credible” incidents-what constitutes a credible incident is always subjective. Nevertheless, guidelines have evolved over the years and based on basic engineering judgment, the cases have been found to be credible and modeling for assessing vulnerability zones is prepared accordingly.

The objective of the study is Emergency planning, hence only holistic & conservative assumptions are used for obvious reasons. Hence, though the outcomes may look pessimistic, the planning for emergency concept should be borne in mind whilst interpreting the results.

In Consequence analysis, geographical location of the source of potential release plays an important role. Consideration of a large number of scenarios in the same geographical location serves little purpose if the dominant scenario has been identified and duly considered.

The Consequence Analysis has been done for selected scenarios. The details of software used for MCA analysis are described below.

- A computer based version ALOHA is used to calculate toxic and explosive effect of the accidental release of liquid chemicals within the plant area.
- ALOHA models key hazards-toxicity, flammability, thermal radiation (Heat), and over pressure (expansion blast force)-related to chemical releases that result in toxic gas dispersion, fire and/or explosion

7.11. Risk analysis

Risk Analysis – Thionyl chloride/ Solvents (Methanol, IPA and Acetone)

The main hazard Toxic gas release associated with the storage and handling of Thionyl chloride with respect to the proposed Unit.

Hazards associated with the storage and handlings of Flammable chemicals (Solvents) are pool fire and VCE's resulting from the ignition of released material. The hazards may be realized during tank overfilling and leaks/failures in the storage tank and ancillary equipment such as transfer pumps, metering equipment, etc. all of which can release significant quantities of flammable material or toxic material on failure.

7.12 Risk Modeling Scenarios

In addition to overfill, the scenarios considered for liquid and gaseous

Chemical leaks and catastrophic failures. Factors that have been identified as having an effect on the integrity of tanks are related to design, inspection, maintenance, and corrosion.

From the liquid chemicals Thionyl chloride has been considered for the consequences analysis considering its hazardous nature, Storage conditions and threshold values.

From the Solvents – Methanol, Acetone, IPA have been considered for the consequences analysis considering their hazardous nature, Storage conditions and threshold values.

RISK & VULNERABLE AREAS

SITE DATA:

Location: SGR LABORATORIES, TELANGANA, INDIA

CHEMICAL DATA:

Chemical Name: ACETONE

CAS Number: 67-64-1

Molecular Weight: 58.08 g/mol

Ambient Boiling Point: 55.6° C

ATMOSPHERIC DATA:

Wind: 1 meters/second from N at 3 meters

Ground Roughness: open country

Air Temperature: 44.5° C

Relative Humidity: 65%

SOURCE STRENGTH:

Leak from hole in vertical cylindrical tank

Flammable chemical is burning as it escapes from tank

Tank Diameter: 2.5 meters

Tank Length: 5.2 meters

Tank Volume: 25.5 cubic meters

Tank contains liquid

Internal Temperature: 30° C

Chemical Mass in Tank: 16000 kilograms

Tank is 80% full

Circular Opening Diameter: 4 inches

Opening is 2 inches from tank bottom

Total Amount Burned: 15907 KGS

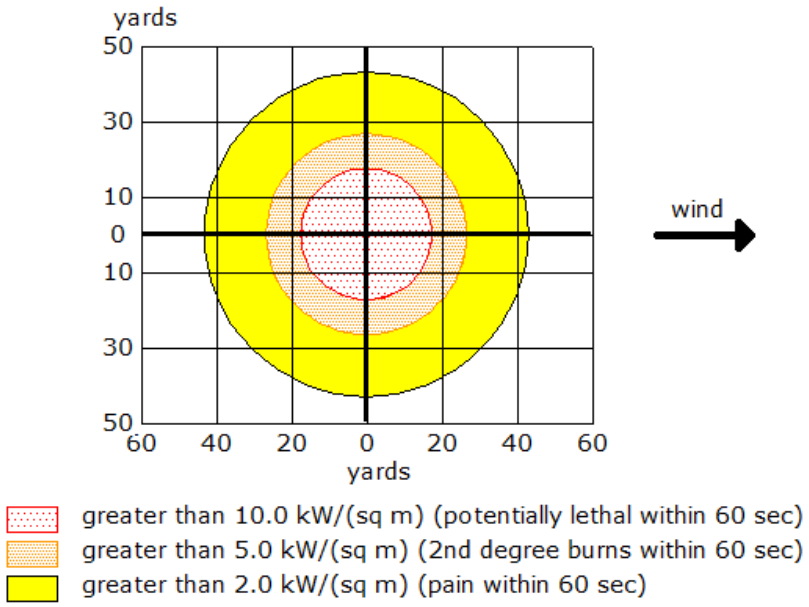
THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 17 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)

Orange: 27 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)

Yellow: 43 yards --- (2.0 kW/(sq m) = pain within 60 sec)



In case the Leakage of Acetone from storage tank got ignited, the vulnerable areas, which are in radius of 15.5 meters within a minute, will get affected.

The Thermal radiation from pool fire of Acetone having value of 10 kw/sqm is potentially lethal to the plant personnel from North of the plant with in the radius of 15.5 meters .The plant personnel with in radius of 24.6 meters are vulnerable for second degree burns within a minute.

The leakage of Acetone in the plant and its consequence considered as Major and its likelihood is unlikely

Significance = Likelihood X Consequence

=3*4

=12

As defined in Risk Criteria and action requirements

The risk significance is Medium.

“Risk is tolerable” –

Mitigation measure: It is Flammable liquid. Storage tank should be checked at regular intervals for any corrosion, weak joints and tank bottom isolation valve for

its operating condition and earthing of the tank. Check regularly earth pit resistance. At any point of time do not place any ignition source near by the tank.

In case of fire use fire hydrant system to extinguish the fire in order to minimize the risk level and avoid fire spread to other areas of the plant. Inform plant head for emergency preparedness. Put water curtain on adjacent tanks to avoid heat radiation to contents of the tank.

Each tank will have dyke wall in all four sides and capacity of dyke wall will retain entire contents of storage tank in case leakage of its contents.

Each tank is fitted with Flame arrestor.

The fabrication and installation of Storage tank will be as per the Petroleum rules - 2002.

Construction of tank will be as per IS 10987(1992).

The scale of fire fighting will be provided as per Oil Industry Safety Directorate (OISD) Standard-117 and it will be approved by Chief controller of explosives.

For firefighting water storage tank will be provided and water will be sufficient for four hours.

Adequate fire hydrants and fire extinguishers will be provided as per OISD-117 Standard.

Capacity of each fire hydrant will have water flow rate of 36m^3 /hr at a pressure of 7 kg/cm^2

Flash Point: -20 deg C

In view of low flash point continuously Acetone vapors will be generated from the tank contents hence, to condense the vapors a heat exchanger will be fitted to the vent .The condensing liquid will be put back to Storage tank

Explosion Limits, Lower: 2.6 vol % Upper: 12.8 vol %

To avoid formation of explosive limits Nitrogen positive pressure will be arranged in the tank.

CHEMICAL DATA:

Chemical Name: METHANOL

CAS Number: 67-56-1

Molecular Weight: 32.04 g/mol

Ambient Boiling Point: 64° C

ATMOSPHERIC DATA:

Wind: 1 meters/second from N at 3 meters

Ground Roughness: open country

Air Temperature: 44.5° C

Relative Humidity: 65%

SOURCE STRENGTH:

Leak from hole in vertical cylindrical tank

Flammable chemical is burning as it escapes from tank

Tank Diameter: 2.5 meters

Tank Length: 5.2 meters

Tank Volume: 25.5 cubic meters

Tank contains liquid

Internal Temperature: 30° C

Chemical Mass in Tank: 16000 kilograms

Tank is 80% full

Circular Opening Diameter: 4 inches

Opening is 2 inches from tank bottom

Total Amount Burned: 14999 KGS

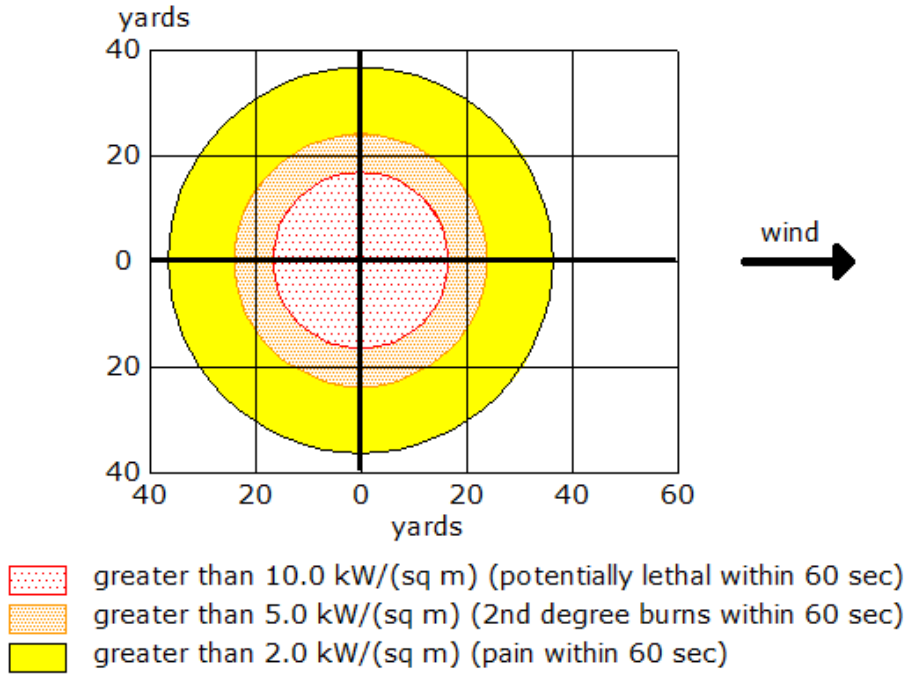
THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 17 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)

Orange: 24 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)

Yellow: 36 yards --- (2.0 kW/(sq m) = pain within 60 sec)



In case the Leakage of Methanol from storage tank got ignited, the vulnerable areas, which are in radius of 15.5 meters within a minute, will get affected.

The Thermal radiation from pool fire of Methanol having value of 10 kw/sqm is potentially lethal to the plant personnel towards North side of the plant with in the radius of 15.5 meters.

The plant personnel will be vulnerable for second degree burns within the radius of 21.9 meters in a minute.

The fire due to leakage of Methanol in the plant and its consequence considered as Major and its likelihood is unlikely

Significance = Likelihood X Consequence

=3*4 =12

As defined in Risk Criteria and action requirements

The risk significance is Medium.

“Risk is tolerable” –

Mitigation measure: It is highly flammable liquid in presence of open flames and spark. Storage tank should be checked at regular intervals for any corrosion, weak joints and tank bottom isolation valve for its operating condition and earthing of the tank. Check regularly earth pit resistance. At any point of time do not place any ignition source near by the tank.

In case of fire use fire hydrant system and fire extinguisher -alcohol foam to extinguish the fire in order to minimize the risk level and avoid fire spread to other areas of the plant.

Inform plant head for emergency preparedness. Put water curtain on adjacent tanks to avoid heat radiation to contents of the tank.

Each tank will have dyke wall in all four sides and capacity of dyke wall will retain entire contents of storage tank in case leakage of its contents.

Each tank is fitted with Flame arrestor.

The fabrication and installation of Storage tank will be as per the Petroleum rules - 2002.

Construction of tank will be as per IS 10987(1992).

The scale of fire fighting will be provided as per Oil Industry Safety Directorate (OISD) Standard-117 and it will be approved by Chief controller of explosives.

For firefighting water storage tank will be provided and water will be sufficient for four hours.

Adequate fire hydrants and fire extinguishers will be provided as per OISD-117 Standard.

Capacity of each fire hydrant will have water flow rate of 36m^3 /hr at a pressure of 7 kg/cm^2

Flash Point: 12 deg C

In view of low flash point continuously Methanol vapors will be generated from the tank contents hence, to condense the vapors a heat exchanger will be fitted to the vent .The condensing liquid will be put back to Storage tank

Explosion Limits, Lower: 6 vol % Upper: 36.5 vol %

To avoid formation of explosive limits Nitrogen positive pressure will be arranged in the tank.

CHEMICAL DATA:

Chemical Name: ISOPROPANOL

CAS Number: 67-63-0

Molecular Weight: 60.10 g/mol

Ambient Boiling Point: 81.8° C

ATMOSPHERIC DATA:

Wind: 1 meters/second from N at 3 meters

Ground Roughness: open country

Air Temperature: 44.5° C

Relative Humidity: 65%

SOURCE STRENGTH:

Leak from hole in vertical cylindrical tank

Flammable chemical is burning as it escapes from tank

Tank Diameter: 2.5 meters

Tank Length: 5.2 meters

Tank Volume: 25.5 cubic meters

Tank contains liquid

Internal Temperature: 30° C

Chemical Mass in Tank: 16000 kilograms

Tank is 81% full

Circular Opening Diameter: 4 inches

Opening is 2 inches from tank bottom

Total Amount Burned: 15904 KGS

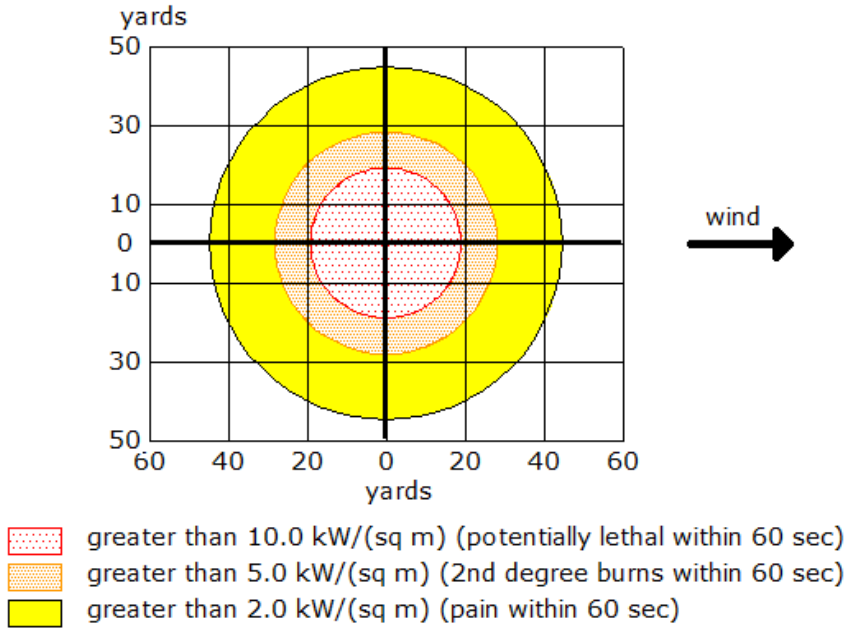
THREAT ZONE:

Threat Modeled: Thermal radiation from pool fire

Red : 19 yards --- (10.0 kW/(sq m) = potentially lethal within 60 sec)

Orange: 28 yards --- (5.0 kW/(sq m) = 2nd degree burns within 60 sec)

Yellow: 45 yards --- (2.0 kW/(sq m) = pain within 60 sec)



In case the Leakage of IPA from storage tank got ignited, the vulnerable areas, which are in radius of 17.3 meters within a minute, will get affected.

The Thermal radiation from pool fire of IPA having value of 10 kw/sqm is potentially lethal to the plant personnel towards south side of the plant with in the radius of 17.3 meters .The plant personnel with in radius of 25.6 meters are vulnerable for second degree burns within a minute.

The leakage & fire of IPA in the plant and its consequence considered as Major and its likelihood is unlikely

Significance = Likelihood X Consequence

=3*4 =12

As defined in Risk Criteria and action requirements

The risk significance is Medium.

"Risk is tolerable" –

Mitigation measure: It is flammable liquid in presence of open flames and spark. Storage tank should be checked at regular intervals for any corrosion, weak joints and tank bottom isolation valve for its operating condition and earthing of the tank. Check regularly earth pit resistance. At any point of time do not place any ignition source near by the tank.

In case of fire use fire hydrant system and fire extinguisher -alcohol foam to extinguish the fire in order to minimize the risk level and avoid fire spread to other areas of the plant. Inform plant head for emergency preparedness. Put water curtain on adjacent tanks to avoid heat radiation to contents of the tank.

Each tank will have dyke wall in all four sides and capacity of dyke wall will retain entire contents of storage tank in case leakage of its contents.

Each tank is fitted with Flame arrestor.

The fabrication and installation of Storage tank will be as per the Petroleum rules - 2002.

Construction of tank will be as per IS 10987(1992).

The scale of fire fighting will be provided as per Oil Industry Safety Directorate (OISD) Standard-117 and it will be approved by Chief controller of explosives.

For firefighting water storage tank will be provided and water will be sufficient for four hours.

Adequate fire hydrants and fire extinguishers will be provided as per OISD-117 Standard.

Capacity of each fire hydrant will have water flow rate of 36m^3 /hr at a pressure of 7 kg/cm^2

Flash Point: 18.3 deg C

In view of low flash point continuously IPA vapors will be generated from the tank contents hence, to condense the vapors a heat exchanger will be fitted to the vent .The condensing liquid will be put back to Storage tank

Explosion Limits, Lower: 2 vol % Upper: 12.7 vol %

To avoid formation of explosive limits Nitrogen positive pressure will be arranged in the tank.

CHEMICAL DATA:

Chemical Name: THIONYL CHLORIDE

CAS Number: 7719-9-7

Molecular Weight: 118.97 g/mol

Ambient Boiling Point: 75.3° C

ATMOSPHERIC DATA:

Wind: 1 meters/second from N at 3 meters

Ground Roughness: open country

Air Temperature: 44.5° C

Relative Humidity: 65%

SOURCE STRENGTH:

Direct Source: 100 kilograms

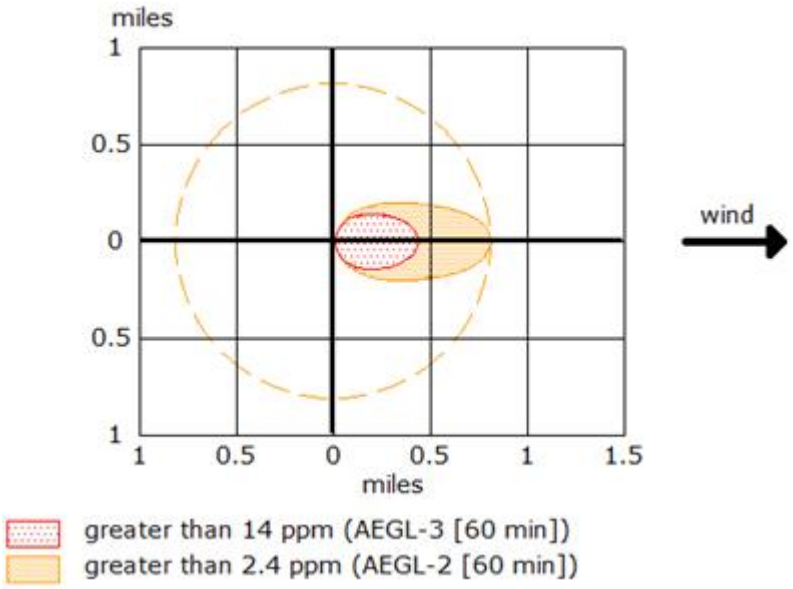
Total Amount Released: 100 KGS

THREAT ZONE:

Model Run: Heavy Gas

Red : 783 yards --- (14 ppm = AEGL-3 [60 min])

Orange: 1436 yards --- (2.4 ppm = AEGL-2 [60 min])



The leakage of Thionyl chloride liquid and its consequences are considered as Minor and its likelihood is probable

Significance = Likelihood X Consequence

=2*4 =8

As defined in Risk Criteria and action requirements

The risk significance is low.

“Risk is Acceptable.” –

Mitigation measure: During unloading from Drum if unloading transfer pipe is not fixed properly there may be sudden leakage of contents on to the ground. This results in formation toxic area of vapor cloud of AEGL value 14 ppm up to a distance of 715 mts in which people may experience life threatening health effects within one hour.

AEGL value having more than 2.4 ppm up to a distance of 1313 mts in which people may experience long lasting adverse health effects within one hour towards N side of the plant.

During transfer of material it is advisable to use Air operated double diaphragm pumps where spillages can be eliminated. While transferring the material the responsible officer should be present.

7.13. OCCUPATIONAL HEALTH

Hazardous and toxic substances will be defined as those chemicals present in the work place which are capable of causing harm.

- For handling hazardous chemicals and to take care of employee's health, and predictive maintenance looking to the nature of hazardous chemicals being handled/processed. All the equipments in the plant areas shall be inspected / tested by an outside agency.
- The various safety equipments like breathing apparatus and critical instrumentation will be provided on various equipments are inspected and tested frequently to ensure their operability all the time. Besides, all the first aid, fire fighting devices will be inspected, tested and maintained by a competent third party and kept all the time in ready to use condition.
- Health of all the employees in plant area will be monitored by outside physician. If any abnormality is found necessary treatment is also being given time to time. Necessary history cards, records will be maintained which is up-dated time to time.

Common Hazards

- Physical such as ventilation, poor illumination, noise, extreme temperature, humidity and radiation.
- Biological such as variety of pathogenic bacteria and parasites.
- Chemical due to hazardous gases and dusts.
- Ergonomic.

Industrial Hygiene Monitoring

- Industrial hygiene monitoring is to be located and identify source of exposure in the workplace so that they can be corrected and to quantify the exposure of employees to chemicals in the air.
- Air monitoring is conducted by industrial hygienists or other trained personnel.

Occupational Health Monitoring System

A. Air samples

Locations of samples – air samples are generally collected in one or three locations:

- At the breathing zone of the worker [Personal sample]
- In the general room air [Area sample]
- At the operation which is generating the hazardous substance [Area sample]

Lengths of samples – Air samples are generally collected for two lengths of time.

- Grab samples [instantaneous] measure conditions at one moment in time and can be linked to a still photograph. They give only a picture of conditions at one place at one instant in time.
- Continuous Samples [range from twenty minutes to 8 – 10 Hours].These is used to evaluate all day exposure by a series of continuous samples.

B. Other sampling methods

Bulk samples

Bulk samples will be collected from settled dust in the work place or from drums or bags. Their purpose is to analyze and identify the substances present. For example, bulk samples are used to analyze the percent of asbestos in insulation, dust & Chemical Powder. Usually, a substance which is greater than one percent of bulk sample is considered a concern.

Wipe Samples

Wipe samples will be used when skin absorption or ingestion is a suspected route of exposure. The purpose is to show whether skin, respirators, clothing, lunch rooms, lockers, etc. are contaminated.

It can show which surfaces are clean and which are contaminated. It can also show if some surfaces are more contaminated than others.

7.13.1 Sampling Devices

The general principle of sampling is to collect an amount of a contaminant onto a medium from a known quantity of air.

Air samples will be collected using small pumps to suck air from the workroom. The pump is attached by tubing to a sampling device which contains the sampling medium; for example a glass tube containing charcoal.

The sampling method will be used depends on the physical form of the substance:

- DUSTS –The sampling device is a filter of plastic or paper in s holder:
- VAPORS –The sampling device is a glass tube containing activated charcoal as a medium.

- GASES –The sampling device is a bubbler containing a fluid medium to dissolved or react with the gas

The collected samples will be sent to a laboratory where the amount of the substance on the sampling medium [filter, tube, etc.] is measured.

In some cases air monitoring will be conducted by using direct reading instrument such as a monitoring for carbon monoxide these instruments can measure the amount of a contaminant in the air immediately without being sent to a laboratory.

- **PEL**s [**P**ermissible **E**xposure **L**imits] – these are legal's limits which have been established by OSHA.
- Recommended **PEL**s – also reference to as **REL**s [**R**ecommended **E**xposure **L**imits] often these values are based on more recent scientific information than the legal PELs enforced by OSHA.
- **TLV**s [**T**hreshold **L**imit **V**alues] – These are exposure limits put out by a nongovernmental group, the **ACGIH** [**A**merican **C**onference of **G**overnmental **I**ndustrial **H**ygienists]. Many of these were adopted as legal requirements. Revised TLVs are often based on the most recent and accurate scientific information.
- Permissible Exposure Limits by **OSHA** [**O**ccupational **S**afety and **H**ealth **A**dministration] when it started back in 1970.
- **IDLH** [**I**mmediate **D**angerous to **L**ife or **H**ealth] limits are prescribed by **NIOSH** [**N**ational **I**nstitute **of O**ccupational **S**afety and **H**ealth]
- **PAC** [Protective action criteria] for Hazardous chemicals prescribed by Emergency management issues special interest group, UNITED STATES.
- **AEGL** [Acute exposure guideline levels] values given by U.S. Environmental protection agency.

7.14 CHEMICALS EXPOSURE LIMITS

TABLE: 7 .6 CHEMICAL EXPOSURE LIMITS

S. No	Chemical name	ACGIH [TLV] ppm	OSHA [PEL] ppm
1	Methanol	200	200
2	Toluene	50	200
3	IPA	200	400
3	Acetone	500	1000
4	Ethyl acetate	400	400
5	MDC	50	500
6	Cyclohexane	300	300
7	Thionyl chloride	1	1
8	n-Hexane	50	50

Notes:

- All the above Values are in **ppm**
- PPE Means Personal Protective Equipment like Helmets, Safety Google, Breathing apparatus, Nose Masks, Gloves, Gum Shoes etc.,

EMP for the Occupational Safety & Health Hazards: Chemicals exposure can be kept within permissible exposure level (PEL) / Threshold Limit value (TLV) so as to protect health of workers.

1. It is proposed to formulate and implement an EMP for Occupational Safety and Health with following aim:

- To keep air-borne concentration of toxic and hazardous chemicals below PEL and TLV.
- Protect general health of workers likely to be exposed to such chemicals
- Providing training, guidelines, resources and facilities to concerned department for occupational health hazards
- Permanent changes to workplace procedures or work location to be done if it is found necessary on the basis of findings from workplace Monitoring Plan.

2. Proposed EMP will be incorporated in Standard Operating Procedure also

3. The proposed EMP will also include measure to keep air-borne concentration of toxic and hazardous chemicals below its PEL and TLV, like

- Leak Surveys

- Separate storage for toxic chemicals
- Exhaust Ventilation
- Proper illumination
- Close processes to avoid spills and exposures
- Atomization of process operations to hazards of manual handling of chemicals
- Supply of proper PPEs like Air mask, Breathing canisters, Decontamination procedure for empty drums and carboys.
- Regular maintenance program for pumps, equipment, instruments handling toxic and corrosive chemicals
- Display of warning boards
- Training to persons handling toxic and corrosive chemicals.

4. Workplace Monitoring Plan

- It is proposed that a Workplace Monitoring Plan to be prepared & implemented accordingly.
- Each workplace must be evaluated to identify potential hazards from toxic substances or harmful physical agents. Air-borne concentration of toxic chemicals will be measured and record will be kept.
- The current state-of-the-art exposure measurement model is as follows: For purposes of measuring worker exposure across a single shift it is sufficient to place a reasonably accurate exposure measuring device near the worker's area, within the worker's breathing zone, and have it operate for nearly the full shift. Client has been proposed to study the exposure data when the plant is operative.

5. Health Evaluation of Workers

- It is proposed that management will devise a plan to check and evaluate the exposure specific health status evaluation of workers.
- Workers will be checked for physical fitness with special reference to the possible health hazards likely to be present, where he/she is being expected to work before being employed for that purpose. Basic examinations like

  1. Liver Function tests
  2. Chest X-ray
  3. Audiometry

4. Spirometry Vision testing (Far & Near vision, color vision and any other ocular defect)
5. ECG, etc. will be carried out.

However, the parameters and frequency of such examination will be decided in consultation with Factory Medical Officer.

- While in work, all the workers will be periodically examined for the health with specific reference to the hazards which they are likely to be exposed to during work. Health evaluation will be carried out considering the bodily functions likely to be affected during work. The parameters and frequency of such examination will be decided in consultation with Factory Medical Officer. Plan of monthly and yearly report of the health status of workers with special reference to Occupational Health and Safety, will be maintained.

7.15. TREATMENT OF WORKERS AFFECTED BY ACCIDENTAL SPILLAGE OF CHEMICALS

[Interim First Aid for General Injuries & Wounds]

Interim First Aid is essential in many injuries while injured waits for trained personnel to arrive.

BLEEDING

- Apply direct pressure on the wound with a clean dressing.
- If bleeding continues and you do not suspect a fracture, elevate the wound above the victim's heart and continue to apply direct pressure.
- If bleeding continues, apply pressure at a pressure point.
- Maintain body temperature.
- Do not use a tourniquet unless this is a serious amputation.

BREATHING PROBLEMS

- Move victim to fresh air if smoke or dangerous gases are present.
- Otherwise, do not move victim.
- If victim loses consciousness, call doctor
- Never enter into a room with toxic gases released -call without protection

UNCONSCIOUS VICTIM

- Move victim to fresh air if smoke or dangerous gases exist.
- Begin rescue breathing- is First Aid trained ahead of time
- Never enter into a room where toxic gases released

CHEMICAL BURNS

- Have victim remain under a safety shower or flush skin with an available water source for 15-30 minutes.
- Remove all contaminated clothing and jewellery.
- Cover burns with dry, loose dressings.
- Wash all clothing thoroughly before wearing it again.

ACID BURNS

- In case of acid burn, the operators with all possible speed gets under a safety shower and use the full flow of water. A small amount of water will incase severity of the burn Water should be used until all traces of acid have been washed from the burn. Alkaline solutions are not needed; if used at all they will use only after all acid has been washed from the burn, it may to treat in the same manner as a heat burn.

CHEMICAL INGESTIONS

- Never enter into a room where toxic gases released, without protection
- Do not give victim any food or liquids without specific advice from physician.

EYE INJURIES FROM CHEMICALS

- Get victim to a safety shower or eye wash immediately.
- Never enter into a room where toxic gases released
- Flush eye for 15-30 minutes with both lids held open. Keep the injured eye lower than the uninjured eye.
- Keep the eyelids open hold fingers at top and bottom of the eyeball. Wrap a bandage loosely around both eyes.

SAFE OPERATING PROCEDURES

- Safe operating procedures will be available for all materials, operations and equipment.

- The workers will be informed of consequences of failure to observe the safe operating procedures.
- Safe operating procedures will be formulated and updated, specific to process & equipment and distributed to concerned plant personnel.
- Safety procedures will be prepared and displayed meticulously in Telugu and English languages.

FIRE PROTECTION

- Well-designed pressured hydrant system comprising with jockey pump, electrical & diesel pumps, hydrant, monitor etc. Will be installed at the plant.
- The fire fighting system and equipment will be tested and maintained as per OISD-117 standard.
- Heat and smoke detectors will be provided at the plant and warehouse (solvent storage area) and calibrated.

STATIC ELECTRICITY

- All equipment and Storage tanks / Containers of flammable chemicals are will be bounded and earthed properly.
- Electrical pits will be maintained clean and covered.
- Electrical continuity for earthing circuits shall be maintained.
- Periodic inspections shall be done for earth pits and record will be maintained.

7.16 COMMUNICATION SYSTEM

Communication facilities will be checked periodically for its proper functioning.

7.17 SAFETY INSPECTIONS

The system will be initiated for checklist based routine safety inspection and internal audit of the plant. Safety inspection team will be formed from various disciplines and departments.

7.18 PREDICTIVE AND PREVENTIVE MAINTENANCE

Predictive and preventive maintenance schedule will be followed in religious manner.

ELECTRICAL SAFETY

- Insulation pad at HT panels will be replaced at regular interval.
- Housekeeping in MCC room will be kept proper for safe working conditions.

COLOUR CODING SYSTEM

Colour coding for piping and utility lines are will be followed in accordance with IS: 2379:1990.

DISASTER MANAGEMENT PLAN

- ONSITE EMERGENCY PLAN
- OFFSITE EMERGENCY PLAN

7.19. ONSITE EMERGENCY PLAN

The details of Onsite emergency plan system are discussed in the following sections

DEFINING THE NATURE / LEVEL OF EMERGENCY

The levels of emergency can be classified in three categories

LEVEL-1

The leakage or emergency which is confinable the plant, premises. It may be due to-

- Small fire in the plant
- Low toxic gas release for short duration.
- Collapsing of equipment that do not affect outside premises.

LEVEL-2

The emergency which is confinable within the factory premises. It may arise due to

- Major fire inside the factory premises.
- Medium scale explosion confined to the factory premises.
- Heavy toxic/flammable gas leakage for short duration.

LEVEL-3

The emergency which is not confinable within the factory premises and general public in the vicinity likely to be affected. It may arise due to

- Explosion of high magnitude affecting the adjacent area
- Heavy/profuse leakage of toxic/flammable gases for a long duration.

7.20 STRUCTURE OF EMERGENCY MANAGEMENT SYSTEM

The company will develop an emergency management team. The management structure includes the following personnel

- Site main Controllers
- Incident Controllers and Deputy Incident Controllers
- Key Personnel's
- Essential Workers

The other elements of Disaster management plan are

- Assembly points
- Emergency control center
- Fire control center
- Medical arrangements
- Other arrangements

7.21 EMERGENCY MANAGEMENT SYSTEM – ROLES & RESPONSIBILITIES

Roles and responsibilities of the responsible persons are described.

7.21.1 SITE MAIN CONTROLLER [SMC]

PLANT HEAD will be the site main controller. In absence of PLANT HEAD, EHS HEAD will act as a SMC.

His task will be to co-ordinate all internal and external activities from the emergency control centre at main security gate from where all operations will be directed. He shall:

- Immediately on being informed of the emergency and its location, will arrive at the scene and handle the situation.
- Relieve the incident controller from responsible of the main controller
- Co-ordinate to avail services from external agencies like fire brigade, hospitals etc. is called for, following the declaration of major emergency. If necessary, major installations in the vicinity may also be informed of the situation.
- Exercise direct operational control of the unaffected section of the plant.

- In consultation with the advisory team, expedite the shutting down of loading/unloading operations of tankers and if necessary, instruct the supervisor/security/personnel to evacuate tankers.
- Ensure that all employees are evacuated from the affected area and the casualties, if any, are given necessary medical attention. Instruct P&A Assistant/security for rushing casualties to hospitals if required.
- Liaise with fire and police officials, pollution control board officials and other statutory bodies and advise them of all possible consequence effects outside the premises.
- Arrange for relief of personnel when emergency is prolonged
- Issue authorized statement or press release to the news –media
- Ensure preservation of evidence for enquiries to be conducted by statutory authorities.
- Authorize the sounding of **"All Clear"** and **"Evacuation Siren"**
- Arrange for obtaining the head-count of all personnel within the premises and cross-checking with the data from records available for no. of persons within the premise.

7.22 INCIDENT CONTROLLER/ DEPUTY INCIDENT CONTROLLER

Role of Incident Controller [Plant Manager/ Shift in Charge]: He is the shift supervisor of the plant. Assume the role of the incident controller and take charge of the situation. Keep the SMC informed of the situation from time to time.

1. Proceed to the scene of emergency and assess the situation
2. Direct all operation within the affected area with the following priorities
   - Safety of personnel
   - Minimize damage to property and loss of material
   - Arrange for rescue of trapped workers and those in a state of shock
   - Get all non-essential persons safely evacuated after stopping all the engineering/hot jobs.
   - Set up a communication system with the main control center at the main security gate through telephone or messenger system.
   - Pending arrival of the main controller, direct the shutting down and evacuation of the site

- Report all developments to the main controller
- Preserve all evidence for use in the subsequent enquiry.
- Intimate to the Emergency Control Center (Main Security Gate) the head count of plant.

7.23 KEY PERSONNEL'S

- Key Personnel are required to provide and to implement the decisions made by the SMC in the light of information received on the developing situation at the time of emergency.
- As necessary, they will decide the actions needed to shut down plants, evacuate personnel, carryout emergency engineering work, arrange for supplies of equipment, utilities, carryout environment monitoring, provide catering facilities, liaise with police, fire brigade and other local authorities, relative of casualties, hospital, press & neighboring industries
- Action at assembly points, outside shelters and mutual aid center under the direction of the SMC.
- All the key personnel and other called in so to assist shall report to the ECC.
- They shall be available at any time on duty or on call or on holiday.

7.24 ESSENTIAL WORKERS

A task force of essential trained workers [Expert's team] is available to get the work done by the Incident controller and the SMC. Such work will include:

- Fire fighting and spill control till a FIRE BRIGADE takes the charge
- To help FIRE BRIGADE and MUTUAL AID teams, if it is so required
- Shutting down plant and making it safe
- Emergency engineering work e.g. isolating equipments, material process, providing temporary by pass lines, safe transfer of materials, urgent repairing or replacement, electrical work, etc
- Provision of emergency power, water, lighting, instruments, equipments, materials, etc
- Movement of equipment, special vehicle and transport to or from the scene of the accident.
- Search, evacuation, rescue and welfare.
- The injured is given First Aid.

- Moving tankers or other vehicles from area of risk.
- Carrying out atmospheric test and pollution control.
- Manning of assembly points to record the arrival of evacuated personnel. Manning for outside shelters and welfare of evacuated persons there.
- Assistance at causalities reception areas to record details of causalities.
- Assistance at communication centers to handle outgoing and incoming calls and to act as messengers if necessary.
- Manning of works entrances in liaison with the police to direct emergency vehicles entering the work. To control traffic leaving the works and to turn away or make alternative safe arrangements for visitors for visitors, contractors and other traffic arriving at the works.
- Inform neighboring factories and the public as directed by the Site Main Controller.
- Any special help required.

7.25 OTHER ELEMENTS OF DMP

There are some other elements of DMP which are described as follows:

7.26.1 ASSEMBLY POINT

Assembly points are those locations where the persons who are not connected with emergency operations can await either for further instructions or for rescue transport and rehabilitation. Presently outside the plant area is considered as such assembly points, taking into consideration of the size of the plant facilities. As the location of security gate is far off the Assembly Point is not vulnerable for emergencies.

- The affected & vulnerable plants, all non-essential workers [who are not assigned any emergency duty] will be evacuated from the area & they shall report to specified Assembly point.
- Assembly Point shall be located at a safe place, well away from area of risk and least affected by the down wind direction.
- To ensure that workers do not have to approach the affected area to reach the Assembly point proper location and numbers have been marked at Assembly point.

- Each Assembly Point is manned by a nominated person to record the names and dept.
- At each Assembly point duties of in - charge shall be displayed in brief.
- Before reaching an Assembly point or subsequently, if it is required to pass through an affected area or due to presence of toxic substances, suitable PPE's including respirators, helmet etc., are issued & made available with workers.

7.26.2 EMERGENCY CONTROL CENTER

The Emergency Control Center is the place or room from where the operations to handle the emergency are directed and coordinated. Main Control Room has been earmarked / identified as the Emergency Control Room. Fire Control Room shall be earmarked / identified as the alternative Emergency Control Room to be operated in case of unfavorable wind direction. Adequate Telecommunication System is available in the Emergency Control Room.

The ECC center has been equipped with the following facilities.

1. Internal and external telephone including STD facility
2. Telephone directory
3. Factory layout plan
4. Map of the area
5. Employee blood group and their address
6. Messengers / Runners for sending messages
7. Adequate numbers of PPE's
8. Telephone nos. of mutual aid centers, Statutory authorities & Hospitals

7.26.3 FIRE SERVICES

Fire Fighting, Gas leak Control and Rescue operation

A] Role of Manager [Fire and Safety/shift in-charge]

- Manager- Fire and Safety/ Shift In-charge will be the only person to direct the fire fighting and emergency operation.
- Keep the constant touch with the chief emergency controller.
- Direct the crew members to the scene of emergency and arrange replenishment of man power/equipment/extinguishing media etc.

B] Fire and Safety officer

- On being notified about the location of fire/gas leakage immediately proceed to the scene of incident with fire tender and crew.
- Position the fire tender in upwind direction.
- Decide his line of action in consultation with incident controller and take appropriate measures to handle the emergency.
- Assessing the severity of the incident immediately report to emergency controller about the gravity of the situation.
- He will assess the extra requirement required if any from the neighboring industry.

C] Fire Crew Members

- On hearing fire alarm, emergency siren they shall immediately report to control room and proceed to the scene of emergency and work under the direction of shift fire & safety officer.
- The personal availability at the scene of incident to be made optimize.

D] Emergency Squad Members

- On hearing Emergency Siren ,they shall immediately report to site main controller, safety in charge or incident controller
- They shall combat the emergency situation as per the direction of site main controller, Safety In- charge or Incident controller
- They shall help for safe evacuation

7.26.4 MEDICAL SERVICES

A] Role of Chief Medical Officer/Medical Officer

- He will contact immediately to chief emergency controller
- He will render necessary treatment as first aid center and hospital.
- He will arrange for hospitalization and treatment at outside hospitals if required.
- He will mobilize extra medical assistance from outside if necessary.
- He will make arrangement for treating public if necessary.

B] Role of other Medical staff

- As directed by medical officers.

7.26.5 SECURITY SERVICES

Role of H.O.D. (Security) / Security Officers

- Receive message from the observer
- Initiate the emergency siren to declare the emergency
- Announce on the public address system
- Arrange to close all the gates and stop traffic
- Keep vehicle/ambulance ready and keep track of casualty sent to hospital during off hours
- Ensure that unauthorized persons/vehicles do not enter the premises
- Organize the positioning and transport of vehicles near the main gate
- Depute security guard for controlling traffic at the scene of emergency
- Call up for additional help from the outside agency like fire brigade, hospitals during off hours.

Role of Security Guard

- On hearing emergency siren contact security officer and work under his directions

7.26.6 MUTUAL AID

In emergency situations, resources over and above those available at the works may be needed. Emergency Coordinator would be contacting neighboring factories for help. A survey of industries who can come to help and also the help, they can extend is done as mentioned below.

- The help would be in the form of technical manpower, medical aid, transport for rescue and Rehabilitation, fire fighting, additional special protective wear or any other help as the case may be.
- Manager – Fire & Safety who is Emergency Coordinator is assigned with this responsibility and he would maintain liaison during non-emergency period and ensure co-operation
- Similarly, the help required from civil administration, in respect of medical aid, transport, law and order, rehabilitation etc. are identified and liaison is established with Mandal Revenue Officer and Police Officials.

7.27 EMERGENCY RESPONSE

Concept of operations deals with the possible steps associated with an emergency response assuming the most severe emergency scenario. This includes:

- Accident initiation and rising of alarm
- Accident evaluation and emergency declaration
- Off site and external agency notification
- Implementation of onsite response actions
- Implementation of protective actions and evacuations
- Co-ordination of response action with external agencies
- Management of emergency resources
- Recovery and facilitate re-entry procedures

7.28 EMERGENCY CAPABILITIES

The primary emergency response facilities comprise with emergency control center upon declaration of emergency, the main security gate office will become the emergency control center [ECC]. The ECC is located in a low /minimal risk zone of the plant.

7.29 EMERGENCY HANDLING PROCEDURES

Action plan

- On hearing emergency declaration siren and announcement on public address system, all key persons will rush to their nominated location and start actions.
- The main controller will continuously assess the situation by taking feedback from the incident controller. He will consult the advisory team members to get essential information if required but if does not required to take help from advisory team; he can assign other jobs to advisory team.
- Once the emergency is brought under control, Main Controller will inform to security to give **"ALL CLEAR"** siren and announce on Public Address System about termination of emergency.

In the case the emergency assumes off site dimensions and cannot be controlled, then if the chief controller with his advisory team decides to evacuate the plant, he will instruct the security to sound "**EVACUATION SIREN"**

Procedure in case emergency tends to have off site implications

- As per the sire plan and wind direction at the time of emergency, the likely affected area will be identified and population within will estimated.
- The police will be informed so that in-coming traffic on highway can be controlled from both the ends. The police force will be helpful in evacuation of villages, factories or other public places in the vicinity
- The fire brigade will be informed and ambulance will be called and kept ready to meet any eventuality.
- Neighboring factories will be communicated for sending help.
- Statutory authorities such as factory inspector, district collector and others concerned to be intimated.

Procedure for salvage operations

- The salvage operation will be carried out under the guidance of the main controller, his advisory team and incident controller.

They will conduct accident investigation; assess the damages-the clock by security supervisors.

During emergency, the main controller and his advisory-team will confirm:

- Layout of facility, equipment and storages, displayed on table and wall
- Availability and location of personal protective equipment
- Self-contained breathing apparatus sets and the spare cylinders
- External telephone with direct dialing and STD facilities/Mobile phone
- Internal telephone
- List of important internal and external telephone numbers displayed on table and wall.
- Transport facility
- Extra copies of plant layout for marking during emergency
- General stationary like paper, pencil etc.
- Nominal roll and address of all employees with contract telephone no’s and blood group
- List of first aiders and emergency squad members
- Details of all contractors and their employees.
- Details of meteorological information during different seasons such as wind speed, direction, temperature, humidity etc.

The location of ECC, Assembly point, availability of first aid boxes, fire extinguishers, PPE should be marked onsite.

7.30 MITIGATION OF ENVIRONMENTAL IMPACT DURING FIRE EMERGENCY

- In case of fire, prevent contact of fire with flammable material or prevent of fire by other means
- Use water or suitable fire extinguisher to extinguish fire
- Contain the contaminated water or any other liquid to prevent it going to soil or drain and divert it to ETP storage tank. If required treat it before sending to ETP tank.
- Any solid waste generated should be collected, stored and send to TSDF site.
- During fire emergency use necessary PPE.
- Bottom valve failure: mitigation of environment impact during failure of between valves or tank failure.
- In case of material coming out of the bottom valve shall be contained inside the dyke wall and will be transferred to HDPE plastic drum by help of pump/piping.
- In case of acid spillage after pumping shall be neutralized and waste shall be cleaned with help of water and send the water to ETP.
- The failed bottom valve shall be replaced or repaired and restart. After tank is empty valve will be repaired, or replaced. In case of leakage form tank body tank will be repaired.
- Preventions of failure: preventive maintenance of bottom value shall be carried out as per schedule. To prevent any leakage from tank body, thickness checking shall be same as per schedule.
- In case of bottom value failure or heavy leakages from tank body material in the tank shall be transferred to the HDPE drums, by running the pump.
- Preventions of failure: preventive maintenance of bottom valve shall be carried out as per schedule. To prevent any leakage from tank body, thickness checking shall be same as per schedule.
- In case of any material leaching the soil it shall be neutralized and washed with water.

7.30.1 RAISING THE ALARM

- Emergency alarm shall be raised in the event of an emergency.
- Any person noticing an unusual occurrence, fire, toxic or corrosive substance leakage etc. shall inform the concerned department/section head/shift in charge immediately and try to control/contain the incident.
- Departmental head/shift in charge will immediately go to the site of incident, assess the situation and initiate the action to “blow the emergency Alarm” by telephoning the main gate to security officer/Asst, security officer/Security supervisor.
- In case of telephone failure a messenger will be sent running to main gate to inform.

Details of siren are given below

Siren codes

- Declaration of emergency:- A long short wailing siren for one minute will mean that there is an emergency within the premises.
- All clear siren: - A long siren for one minute will mean that the emergency declared is under control, i.e. all clear. This siren code will mean All clear, normal condition.
- Evacuation siren: - A long short wailing siren for 3 [three] minutes, will mean that emergency declared cannot be controlled. Hence all persons in the premises will evacuate as per the plan.

7.31 DECLARING MAJOR EMERGENCY

Major emergency may be declared after sufficient thought because it activates many agencies and the nominated persons to declare major emergencies.

7.32 TRANSPORT AND EVACUATION ARRANGEMENTS

- Arrangements shall be made for the transport and evacuation of persons in case of any emergency situation arises in the factory.
- Those employees who have own vehicles will make arrangements to shift the injured.

7.33 PLANT OPERATIONS

1. Role of HOD

- He will take plant related decisions, which will facilitate the fire fighting operation.

2. Plant Employees

They shall:

- On heaving the siren, report to plant supervisor
- Do as directed by plant supervisor
- Stop all hot works
- Remove unwanted persons from the affected area to the “Assembly Point “near main security gate viz visitors, guests
- Stop all non-essential operations

3. Non-plant Employees

On hearing the siren, shall stop their work assemble at “Assembly Point” near main security gate along with guests and visitors.

7.34 TELEPHONE MESSAGES

Telephone operator has to pay vital role in case of emergency. After hearing the siren/ hooter, he/ she should inform to all key personnel immediately on phone. He/ she should receiving be very sharp, precise, attentive and quick in & noticing the message.

7.35 MOCK DRILL

In spite of detailed training, it may be necessary to try out whether, the OSEP works out and will there be any difficulties in execution of such plan. In order to evaluate the plan and its effectives of meeting the objective of the OSEP, occasional mock drills are contemplated. After a few pre- informed mock drills, few un-informed mock drills would be taken. All this is to familiarize the employees with the concept and procedures and to see their response. These scheduled and unscheduled mock drills would be conducted during shift change, public holidays, in night shifts etc, to improve preparedness. Emergency Coordinator [EHS] is responsible for organizing planned and unplanned mock drills.

Two types of Mock drills are in practice. They are

1. Announced-Once in 3 months
2. Unannounced –Once in 6 months.

Mock drill observation

Mock drill observation team is constituted and they note down the action of various coordinators in chronological order. The time of arrival of each coordinator and their duties are detailed in a note. Immediately after mock drill, the advisory team and emergency coordinators meet and review the mock drill records in chronological order and take note of corrective action. The record of this meeting note is circulated for compliance of concerned.

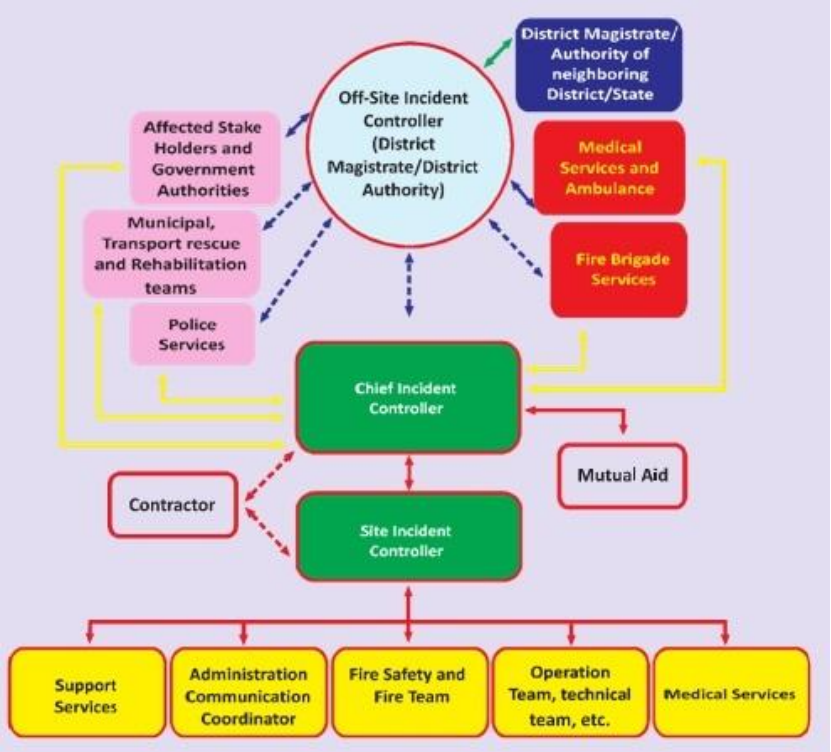
Role of Mock drill observers

- Note readings of plant instruments
- Meteorological conditions
- Time of emergency declaration and time when the personnel responded / reported
- Ambulance reported and time when additional vehicles reported
- Collect information description of the event, estimated quantity of the gas release, fire, contamination and effected levels at various locations, injuries and equipment damage.

7.36 OFFSITE EMERGENCY PLAN

“If the accident is such that its affects inside the factory are uncontrollable and it may spread outside the factory premise, it is called as **“OFFSITE EMERGENCY”**

FLOWCHART FOR OFFSITE EMERGENCY PLAN



The Offsite emergency plan is made based on events, which could affect people and Environment outside the premises. The off site plan is largely a matter of ensuring the co-ordination of proposed services and their readiness as far as possible, for the specific hazards and problems, which may arise in as incident. Briefly two main purposes of the plan are as under:

To provide the local district authorities, police, fire brigade, doctors etc. the basic Information of risk and environmental impact assessment and to appraise them of the consequences and the protection / prevention measures and control plans and to seek their help to communicate with the public in case of major emergency.

To assist the district authorities in preparing the **Offsite** emergency plan of the district or particular area. We will make our key personnel and others fully aware about this off-site emergency plan. The function of the offsite plans are as under:

Structure of the offsite emergency plan includes the following:-

- Organizational set up-Incident controller /Site main controller, Key personnel, etc
- Communication facilities - List of important telephones

- Specialized emergency equipment - Firefighting equipment
- Specialized Knowledge - Trained people
- Voluntary Organization - Details of organization
- Chemical information - MSDS of hazardous substances
- Meteorological information - Weather condition such as Wind velocity, Wind Speed, Humidity, Temperature etc
- Humanitarian arrangement - Transport, First aid and Ambulance

7.37 ROLE OF THE FACTORY MANAGEMENT

The **Onsite** and **Offsite** plans are come together so that the emergency services are call upon at the appropriate time and are provided with accurate information and a correct assessment of situation.

7.37.1 ROLE OF LOCAL AUTHORITY

Generally the duty to prepare the off-site plan lies with the local authority. They may have appointed an Emergency Planning Officer (EPO) to prepare whole range of different emergency within the local authority area.

7.37.2 ROLE OF FIRE AUTHORITY

The control of a fire is normally the responsibility of the senior fire brigade officer who would take over the handling of fire from the Incident Controller on arrival at the site.

7.37.3 ROLE OF POLICE

The overall control of an emergency is normally assumed by the police with a senior officer designated as emergency coordinating officer. Formal duties of the police during emergency include protection of life and property and controlling traffic movements.

7.37.4 ROLE OF HEALTH AUTHORITIES

Health authorities, including doctors, surgeons, hospitals, ambulances etc. have a vital role to play following a major accident and they should form an integral part of the emergency plan. Major off site incidents are likely to require medical equipments and facilities in addition to those available locally.

7.37.5 ROLE OF THE "MUTUAL AID" AGENCIES

Some types of mutual aids are available from the neighboring factories, as per need, as a part of the onsite and **Offsite** emergency plan.

7.37.6 ROLE OF THE FACTORY INSPECTORATE

In the event of an accident, the factory inspector will assist the District Emergency Authority for information and help in getting mutual aid from neighboring factories. Unit maintains the records of details of emergency occur, corrective preventive measures taken and in future the same practice will be continued. Unit will be displayed the details like list of assembly points, name of the persons involve in the safety team like **Site Controller**, **Incident** controller etc.